

AMENDMENTS
TO
THE WATER QUALITY CONTROL PLAN FOR THE
SACRAMENTO RIVER AND SAN JOAQUIN RIVER
BASINS

FOR
THE CONTROL OF ORCHARD PESTICIDE RUNOFF AND
DIAZINON RUNOFF INTO THE SACRAMENTO AND
FEATHER RIVERS

DRAFT FINAL STAFF REPORT

APPENDIX G

TOXICITY STUDIES USED IN NOVARTIS RISK
ANALYSIS

Overview

The table below includes the toxicity studies that were reportedly used by Novartis in their ecological risk assessment conducted for the Sacramento-San Joaquin Basins (Novartis, 1997). The studies are from the U.S. Environmental Protection Agency's (USEPA) AQUIRE database, as reported in Table 10 of the Novartis (1997) report.

Since the Novartis report was published, the USEPA has incorporated the AQUIRE database into the ECOTOX database, which can be accessed at:

<http://www.epa.gov/ecotox/>. The table below provides the studies reportedly used by Novartis together with the data attributes reported in the USEPA's ECOTOX database.

Those studies that reported toxicity endpoints based on formulation concentration are shaded. As described by USEPA (2003), a study that is coded with an “F” for formulation represents the concentration of the pesticide product used in the experiment. The pesticide product formulation used in such studies are “[g]enerally reserved for commercial preparation prior to actual use and does not include the final dilution(e.g.; Baythroid, 2,4-D)”. The formulation concentration does not represent the concentration of the active ingredient in the pesticide product, but the concentration of the product itself. The pesticide product may include a significant amount of “inert” ingredients.

As described by USEPA (2003), a study that is coded with an “A” for active ingredient means that the “[a]uthor refers to the concentration as active ingredient, active principle or various grades of reagents.”

References

Novartis Crop Protection, Inc. 1997. Ecological Risk Assessment of Diazinon in the Sacramento-San Joaquin Basins. Technical Report 11/97. Environmental and Public Affairs Department. Greensboro, NC

U.S. Environmental Protection Agency. 2003. EPA: ECOTOX Code List. Accessed on 8/26/2003 & 8/28/2003 at <http://www.epa.gov/ecotox/help/codelist.htm>.

| Scientific name | Common name | Endpoint ^a | Effect/Effect Measured ^b | Duration | Concentration ($\mu\text{g/L}$) ^c | Reference |
|------------------------------------|----------------|-----------------------|-------------------------------------|----------|--|-------------------------------|
| <i>Gammarus fasciatus</i> | Scud | LC50 | MOR | 96 h | A 0.20, 0.15 - 0.28 | Johnson and Finley, 1980 |
| <i>Ceriodaphnia dubia</i> | Water flea | LC50 | MOR | 48 h | F 0.50, 0.43 - 0.61 | Ankley et al, 1991 |
| <i>Daphnia pulex</i> | Water flea | EC50 | ITX/IMBL | 48 h | F 0.90, 0.67 - 1.2 | Sanders and Cope, 1966 |
| | | EC50 | ITX/IMBL | | A 0.8, 0.6 - 1.1 | Johnson and Finley, 1980 |
| | | LC50 | MOR | | F 0.650, 0.53 - 0.80 | Ankley et al, 1991 |
| <i>Daphnia magna</i> | Water flea | EC50 | ITX/IMBL | 48 h | A 0.7, 0.6 - 0.9 | Dortland, 1980 |
| | | EC50 | ITX/IMBL | | F 1.22 | Dennis et al, 1979 |
| | | EC50 | ITX/IMBL | | F 1.25 | Dennis et al, 1979 |
| | | EC50 | ITX/IMBL | | A 1.5, 1.3 - 1.6 | Dortland, 1980 |
| | | EC50 | ITX/IMBL | | A 0.8, 0.7 - 1.0 | Dortland, 1980 |
| | | LC50 | MOR | | F 0.56 - 1.0 | Maas, 1982 |
| | | LC50 | MOR | | F 0.96, 0.83 - 1.10 | Vilkas, 1976 |
| | | LC50 | MOR | | F 0.80, 0.65 - 1.00 | Ankley et al, 1991 |
| | | LC50* | MOR | | F 2.0 | Meier et al, 1979 |
| | | EC50 | ITX/IMBL | 48 h | F 1.4, 1.2 - 1.6 | Sanders and Cope, 1966 |
| <i>Simocephalus serrulatus</i> | Water flea | | | | F 1.8, 1.4 - 2.2 | Sanders and Cope, 1966 |
| <i>Gammarus pseudolimnaeus</i> | Scud | LC50 | MOR | 96 h | F 2, 1 - 3 | Morgan, 1976 |
| <i>Arcatoa tonsa</i> | Copecod | N/A | N/A | N/A | N/A | Khattat and Farley, 1976 |
| <i>Cloeon dipterum</i> | Mayfly | LC50* | MOR | 48 h | F 7.8 | Hashimoto and Nishiuchi, 1981 |
| <i>Orconectes propinquus</i> | Crayfish | LC50 | MOR | 7 d | F 15, 4.6 - 25.4 | Morgan, 1976 |
| <i>Acroneuria ruralis</i> | Stonefly | LC50 | MOR | 96 h | F 16, 9 - 23 | Morgan, 1976 |
| <i>Asellus communis</i> | Aquatic sowbug | LC50 | MOR | 96 h | F 21, 15 - 27 | Morgan, 1976 |
| <i>Hyalella azteca</i> | Scud | LC50 | MOR | 48 h | F 22, 19 - 25 | Morgan, 1976 |
| <i>Chasmichthys dolichognathus</i> | Agohaze, goby | LC50 | MOR | 72 h | F 33 | Hirose et al., 1979 |
| | | | | 72 h | F <10 - 16 | Hirose et al., 1979 |
| | | | | 72 h | F 80 | Hirose et al., 1979 |
| | | | | 96 h | F 80, 50 - 130 | Hirose et al., 1979 |
| | | | | 96 h | F 16, 10 - 25 | Hirose et al., 1979 |
| | | | | 96 h | F <10 | Hirose et al., 1979 |
| <i>Baetis intermedius</i> | Mayfly | LC50 | MOR | 96 h | F 24, 6 - 42 | Morgan, 1976 |
| <i>Pteronarcys californicus</i> | Stonefly | LC50 | MOR | 96 h | F 25.0 | Cope, 1966 |
| <i>Seriola quinqueradiata</i> | Yellowtail | LC50* | MOR | 48 h | F 40 | Hirose and Kitsukawa, 1976 |
| <i>Paraleptophlebia pallipes</i> | Mayfly | LC50 | MOR | 96 h | F 44, 15 - 73 | Morgan, 1976 |
| <i>Physa gyrina</i> | Pouch snail | LC50 | MOR | 96 h | F 48, 36 - 60 | Morgan, 1976 |
| <i>Lestes congener</i> | Damselfly | LC50 | MOR | 96 h | F 50 | Federle and Collins, 1976 |
| <i>Anguilla anguilla</i> | Common eel | LC50 | MOR | 96 h | F 80, 60 - 100 | Ferrando et al, 1991 |

| Scientific name | Common name | Endpoint ^a | Effect/Effect Measured ^b | Duration | Concentration ($\mu\text{g/L}$) ^c | Reference |
|---------------------------------------|--------------------------------|-----------------------|-------------------------------------|---------------|--|-------------------------------|
| <i>Girella punctata</i> | Green fish | LC50 | MOR | 72 h | F 56 | Hirose et al., 1979 |
| | | | | 72 h | F 220 | Hirose et al., 1979 |
| | | | | 96 h | F 56 | Hirose et al., 1979 |
| | | | | 96 h | F 160, 130 - 190 | Hirose et al., 1979 |
| <i>Orthetrum albistylum speciosum</i> | Dragonfly | LC50* | MOR | 48 h | F 140 | Hashimoto and Nishiuchi, 1981 |
| <i>Leuciscus idus</i> | Ide, silver or golden orfe | LC50 | MOR | 96 h | F 150 | Bathe et al, 1975 |
| <i>Gammarus lacustris</i> | Scud | LC50 | MOR | 96 h | F 200, 150 - 280 | Sanders, 1969 |
| | | | | | F 170, 118 - 222 | Morgan, 1976 |
| <i>Lepomis macrochirus</i> | Bluegill | LC50 | MOR | 96 h | A 480, 340 - 670 | Allison and Hermanutz, 1977 |
| | | LC50 | | | A 440, 310 - 620 | Allison and Hermanutz, 1977 |
| | | LC50 | | | F 170 | Dennis et al, 1979 |
| | | LC50 | | | F 530 | Dennis et al, 1979 |
| | | LC50 | | | F 120 | Meier et al., 1979 |
| | | LC50 | | | A 168, 120 - 220 | Johnson and Finley, 1980 |
| | | LC50 | | | F 170 | Dennis et al, 1979 |
| | | LC50 | | | F 530 | Dennis et al, 1979 |
| | | LC50 | | | F 22 | Cope, 1965 |
| | | LC50* | | | T 400 - 800 | Posner and Reimer, 1970 |
| <i>Mugil curema</i> | White mullet | LC50 | MOR | 24 h and 48 h | F 250 | Butler, 1963 |
| <i>Notemigonus crysoleucas</i> | Golden shiner | LC50* | MOR | 96 h | T 400 - 800 | Posner and Reimer, 1970 |
| <i>Misgurnus anguillicaudatus</i> | Oriental weatherfish | LC50* | MOR | 48 h | F 500 | Hashimoto and Nishiuchi, 1981 |
| <i>Helisoma trivolvis</i> | Ramshorn snail | LC50 | MOR | 7 d | F 528, 349 - 707 | Morgan, 1976 |
| <i>Salvelinus namaycush</i> | Lake trout, siscowet | LC50 | MOR | 96 h | A 602, 400 - 906 | Johnson and Finley, 1980 |
| <i>Salvelinus fontinalis</i> | Brook trout | LC50 | MOR | 96 h | A 800, 440 - 1140 | Allison and Hermanutz, 1977 |
| | | LC50 | | | A 450, 320 - 630 | Allison and Hermanutz, 1977 |
| | | LC50 | | | A 1050, 720 - 1520 | Allison and Hermanutz, 1977 |
| | | LC50* | | | T 400 - 800 | Posner and Reimer, 1970 |
| <i>Oncorhynchus mykiss</i> | Rainbow trout, donaldson trout | LC50 | MOR | 96 h | F 1350 | Meier et al, 1979 |
| | | | | | F 90 | Cope, 1965 |
| | | | | | A 400, 230 - 700 | Beliles, 1965 |
| | | | | | F 3200, 2400 - 4200 | Bathe et al, 1975 |
| | | | | | F 455 | Anees, 1975 |
| <i>Channa punctata</i> | Snake-head catfish | LC50 | MOR | 96 h | F 3100 | Sastray and Sharma, 1980 |
| <i>Gambusia affinis</i> | Western mosquitofish | LC50 | MOR | 48 h | F 1273, 977 - 1820 | Li and Chen, 1981 |
| <i>Poecilia</i> | Mollies | LC50* | MOR | 48 h | F 1300 | Tanaka et al, 1984 |

| Scientific name | Common name | Endpoint ^a | Effect/Effect Measured ^b | Duration | Concentration ($\mu\text{g/L}$) ^c | Reference |
|----------------------------------|-------------------------------|-----------------------|-------------------------------------|----------|--|--|
| <i>Cyprinodon variegatus</i> | Sheepshead minnow | LC50 | MOR | 96 h | A 1470, 1070 - 3310 | Goodman et al, 1979 |
| <i>Poecilia sphenops</i> | Molly | LC50 | MOR | 7 d | F 1600 | Chatterjee, 1975 |
| <i>Jordanella floridae</i> | Flagfish | LC50 | MOR | 96 h | A 1500, 1200 - 1900 | Allison and Hermanutz, 1977 |
| | | | | | A 1800, 1600 - 2000 | Allison and Hermanutz, 1977 |
| <i>Hirudo nipponia</i> | Asian leech | EC50* | ITX/IMBL | 48 h | F 1500 F 2400 | Kimura and Keegan, 1966 Kimura and Keegan, 1966 |
| <i>Poecilia reticulata</i> | Guppy | LC50 | MOR | 96 h | F 3000 | Bathe et al, 1975 |
| | | | | | F 3400 | Maas, 1982 |
| | | | | | F 800 | Keizer et al, 1990 |
| <i>Heteropneustes fossilis</i> | Indian catfish | LC50 | MOR | 96 h | F 2270 | Verma et al, 1982 |
| <i>Cyprinus carpio</i> | Common, mirror, colored, carp | LC50 | MOR | 72 h | F 3110 | Toor and Kaur, 1974 |
| | | LC50* | | | F 2000 | Nishiuchi and Asano, 1981 |
| <i>Cyclops</i> | Cyclopoid copepod | LC50 | MOR | 7 d | F 2510 | Chatterjee, 1975 |
| <i>Oncorhynchus clarki</i> | Cutthroat trout | LC50 | MOR | 96 h | A 1700, 1390 - 2090 | Johnson and Finley, 1980 |
| | | LC50* | | | F 3850, 2920 - 5070 | Swedburg, 1973 |
| | | LC50* | | | F 2760, 2280 - 3330 | Swedburg, 1973 |
| <i>Tubifex</i> | Tubificid worm | LC50 | MOR | 7 d | F 3160 | Chatterjee, 1975 |
| <i>Danio rerio</i> | Zebra danio | LC50 | MOR | 96 h | F 2120, 2080 - 2160 | Ansari et al, 1987 |
| | | | | | F 8000 | Keize et al, 1990 |
| <i>Physella acuta</i> | European physa, bladder snail | LC50 | MOR | 48 h | F 4800 | Nishiuchi and Yoshida, 1972 |
| <i>Selenastrum capricornutum</i> | Algae | N/A | N/A | N/A | N/A | Hughes, 1988 |

| Scientific name | Common name | Endpoint ^a | Effect/Effect Measured ^b | Duration | Concentration ($\mu\text{g/L}$) ^c | Reference |
|--------------------------|-------------------|-----------------------|-------------------------------------|----------|--|-----------------------------------|
| Pimephales promelas | Fathead minnow | LC50 | MOR | 96 h | A 6800, 5400 – 8500 | Allison and Hermanutz, 1977 |
| | | | | | A 6600, 5100 – 8600 | Allison and Hermanutz, 1977 |
| | | | | | A 10000, 6700 – 15000 | Allison and Hermanutz, 1977 |
| | | | | | F 5600 – 10000 | Dennis et al, 1979 |
| | | | | | F 3700 | Dennis et al, 1979 |
| | | | | | F 10300 | Meier et al, 1979 |
| | | | | | F 5600 – 10000 | Dennis et al, 1979 |
| | | | | | F 3700 | Dennis et al, 1979 |
| | | | | | A 4300, 3400 – 5200 | Jarvinen and Tanner, 1982 |
| | | | | | A 6100, 5000 – 7600 | Jarvinen and Tanner, 1982 |
| Oryzias latipes | Medaka, high-eyes | LC50* | MOR | 72 h | F <20000 | Asaka et al, 1980 |
| | | | | | F 9100 | Asaka et al, 1980 |
| | | | | | F <2100 | Asaka et al, 1980 |
| Ameiurus melas | Black bullhead | LC50 | MOR | 96 h | F 8000 | Bathe et al, 1975 |
| Carassius auratus | Goldfish | LC50 | MOR | 96 h | A 9000, 7300 – 11200 | Beliles, 1965 |
| Semisulcospira libertina | Marsh snail | LC50 | MOR | 48 h | F 9500 | Nishiuchi and Yoshida, 1972 |
| Carassius carassius | Crucian carp | LC50 | MOR | 96 h | F 5000 | Bathe et al, 1975 |
| | | | | | F 23400, 18700 – 29100 | Bathe et al, 1975 |
| Bufo bufo japonicus | Toad | LC50* | MOR | 48 h | F 14000 | Hashimoto and Nishiuchi, 1981 |
| Indoplanorbis exustus | Snail | LC50* | MOR | 48 h | F 20000 | Hashimoto and Nishiuchi, 1981 |
| Brachionus calyciflorus | Rotifer | LC50 | MOR | 2 d | F 31000 | Snell and Moffat, 1992 |
| | | | | 24 h | F 29220, 28470 – 29960 | Fernandez-Casalderrey et al, 1992 |
| | | | | 24 h | F 29220, 28470 – 29960 | Fernandez-Casalderrey et al, 1992 |

a EC50= “Median Effective Concentration: Effective concentration for 50% of the organisms tested. Used when an effect other than death is the observed endpoint.”

LC50= “Median Lethal Concentration: Statistically estimated concentration that is expected to be lethal to 50% of a group of organisms tested. Death may be defined by the mortality, intoxicification and population effect groups. TLms and TL50s with death as the measured endpoint are reported as LC50.” (USEPA, 2003).

^b MOR= Mortality as measured by Mortality; MOR/SURV= Mortality as measured by Survival; MOR/HTCH= Mortality as measured by Hatchability; ITX/IMBL= Intoxication as measured by Immobility

^c A= Active Ingredient Concentration; F= Formulation Concentration; T= Total Concentration. Note – USEPA codes pesticide concentration effects data with an “F”, if the study did not specify whether reported concentration was based on active ingredient or formulation. The definitions provided by the USEPA for reporting of concentration type are:

F FORMULATION: Generally reserved for commercial preparation prior to actual use and does not include the final dilution (e.g.; Baythroid, 2,4-D). Also included in this category are organic compounds with no pesticidal activity (e.g.; PCB, dioxin).

A ACTIVE INGREDIENT: Author refers to the concentration as active ingredient, active principle or various grades of reagents.

T TOTAL: The concentration of metals determined on an unfiltered sample after vigorous digestion, or the sum of the concentrations of metals in both dissolved and suspended fractions. Heavy metals and single elements (e.g. Na, Cl, Br) are coded as T.